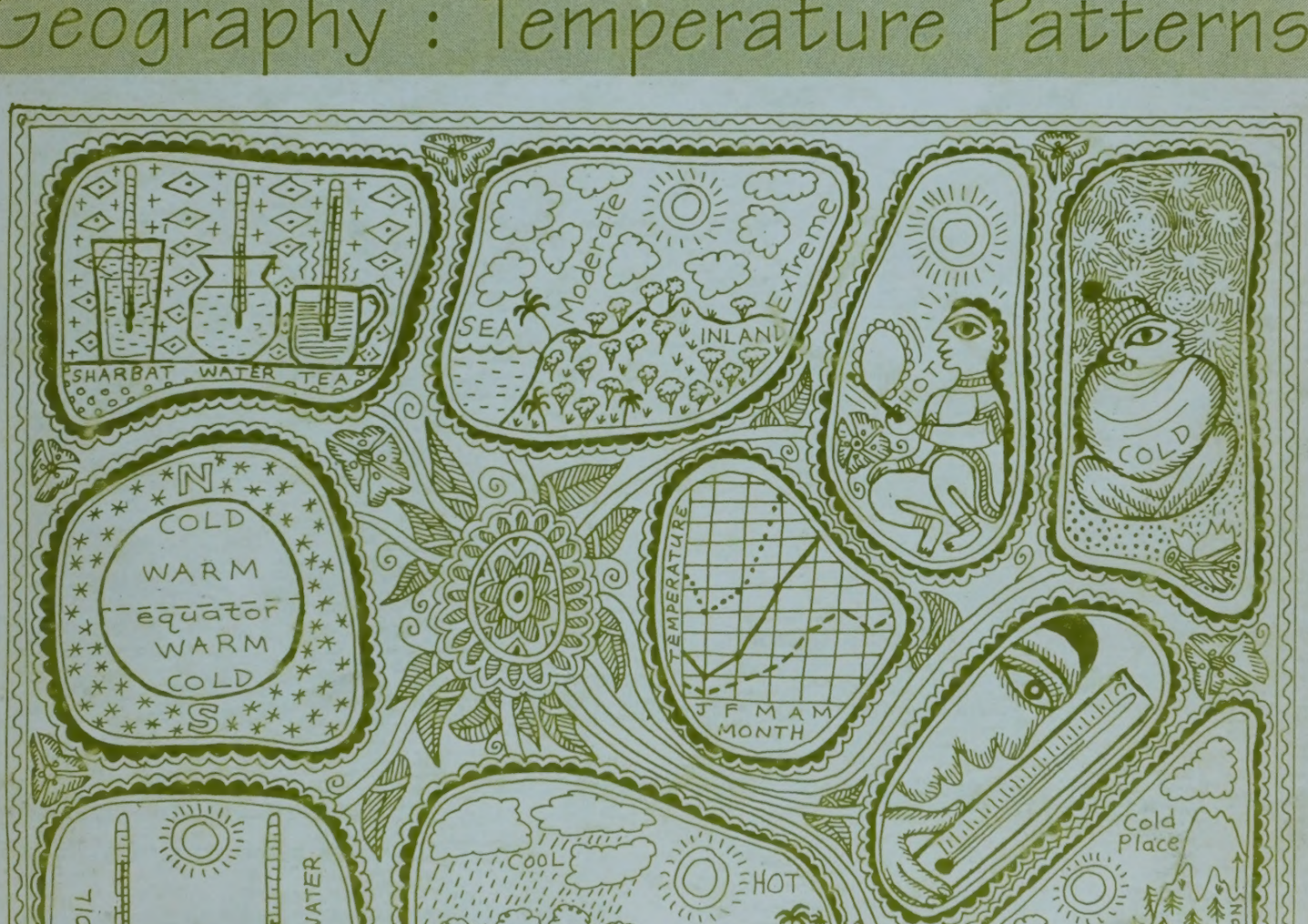
How Hot? How Cold?

Geography : Temperature Patterns



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How hot? How Cold?

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How Hot? How Cold?

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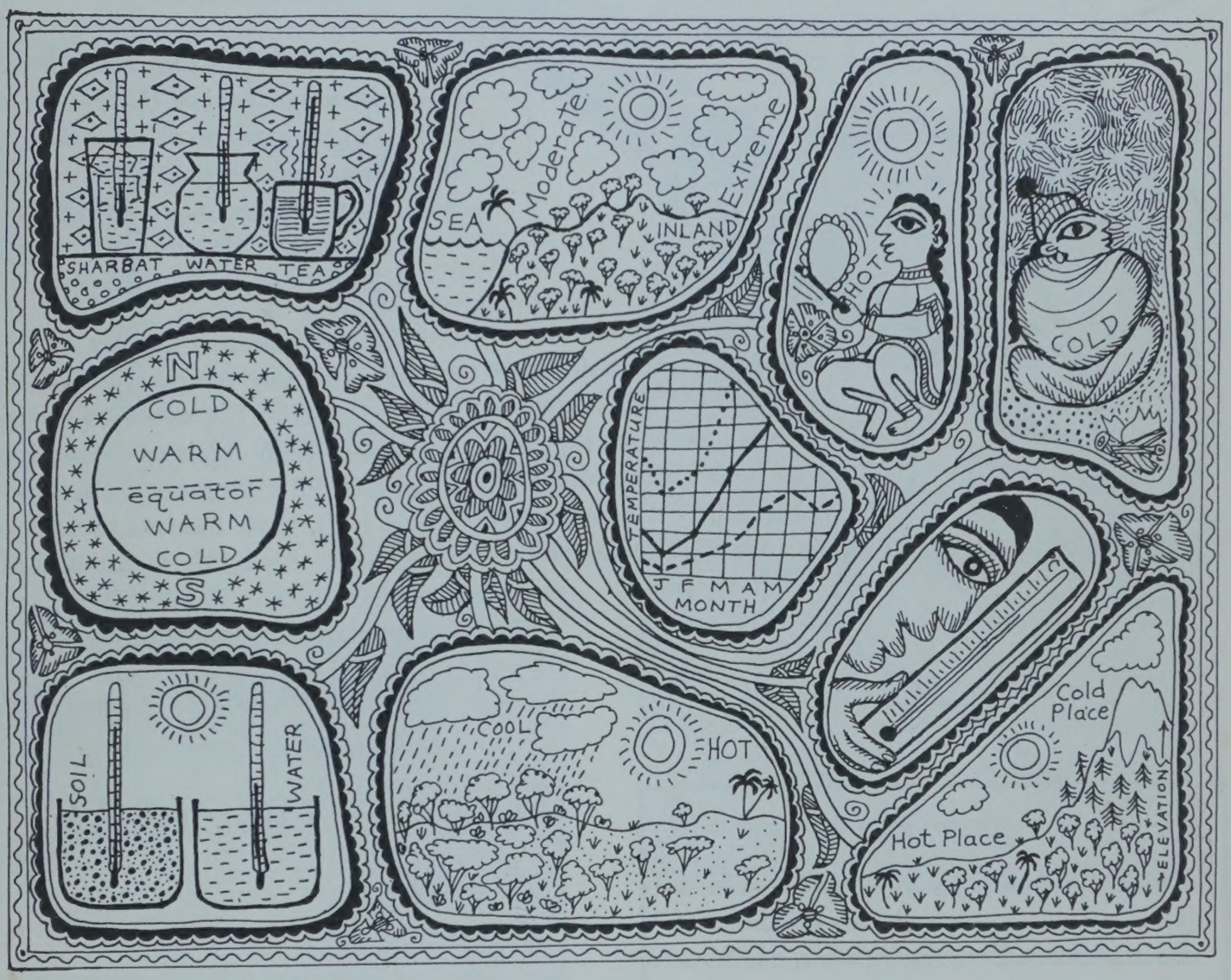


We often talk about how hot it is or how cold it is. Some days are hotter than other days.

Try to remember times when it was very hot, and other times when it was very cold. Write down whatever you remember about those times. Note where you were, what you did, etc.

Heat has a lot of effect on us, and on all living things.

You must already know that some places get hotter than other places. Some parts of India get very hot, and some parts get very cold. Some places on the earth are always quite cold. Some places are usually hot. And some places remain neither very hot, nor very cold.

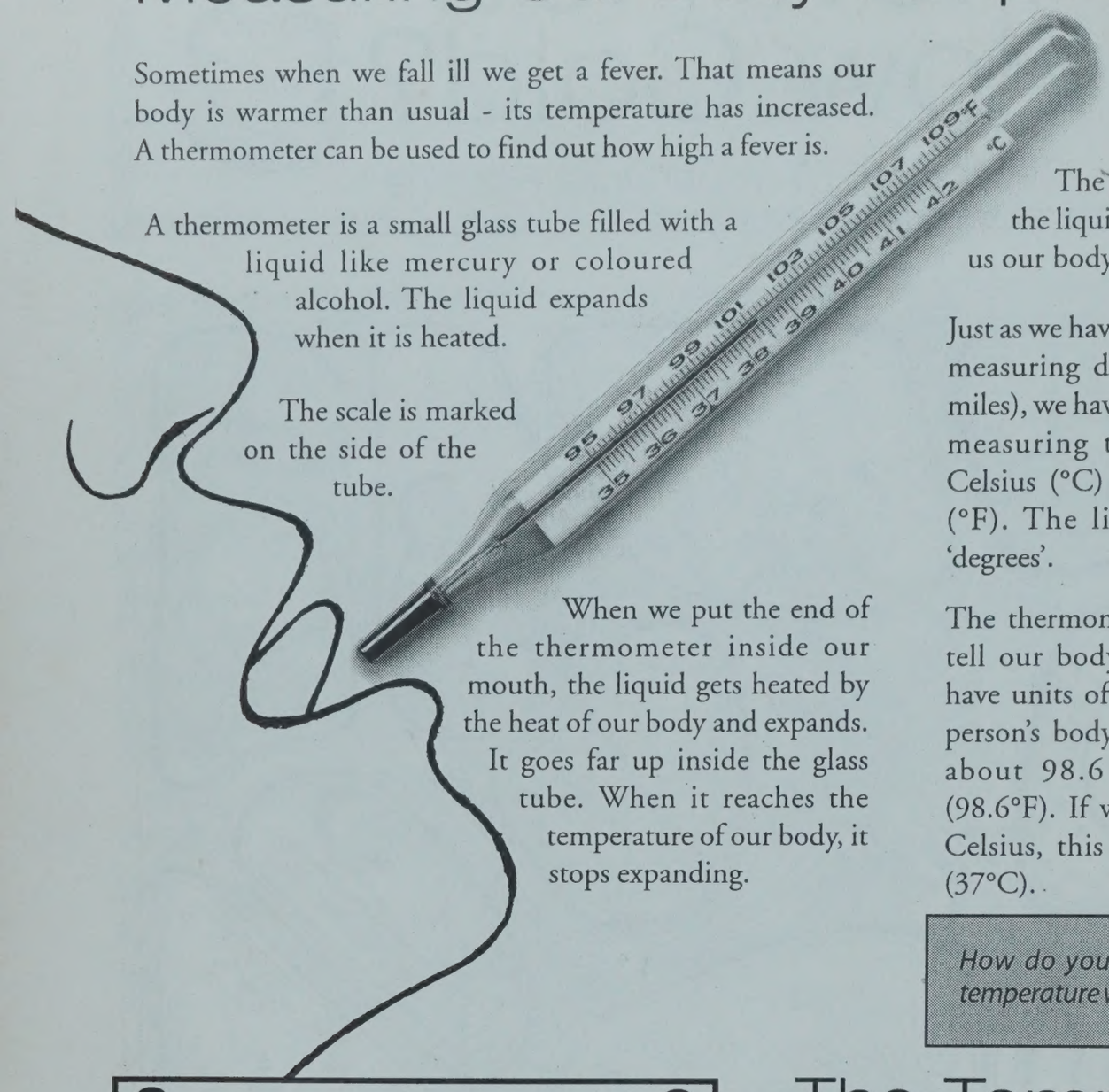
How do we measure how hot a place is? Let's find out.

Measuring Our Body Temperature

Sometimes when we fall ill we get a fever. That means our body is warmer than usual - its temperature has increased. A thermometer can be used to find out how high a fever is.

A thermometer is a small glass tube filled with a liquid like mercury or coloured alcohol. The liquid expands when it is heated.

The scale is marked on the side of the tube.



When we put the end of the thermometer inside our mouth, the liquid gets heated by the heat of our body and expands. It goes far up inside the glass tube. When it reaches the temperature of our body, it stops expanding.

The point on the scale where the liquid comes to a stop shows us our body temperature.

Just as we have two different units for measuring distance (kilometres or miles), we have two different units for measuring temperature: degrees Celsius (°C) or degrees Fahrenheit (°F). The little circle (°) means 'degrees'.

The thermometers that are used to tell our body temperature usually have units of Fahrenheit. A healthy person's body has a temperature of about 98.6 degrees Fahrenheit (98.6°F). If we measure in units of Celsius, this is 37 degrees Celsius (37°C).

How do you find out your body temperature with a thermometer?

BEWARE!

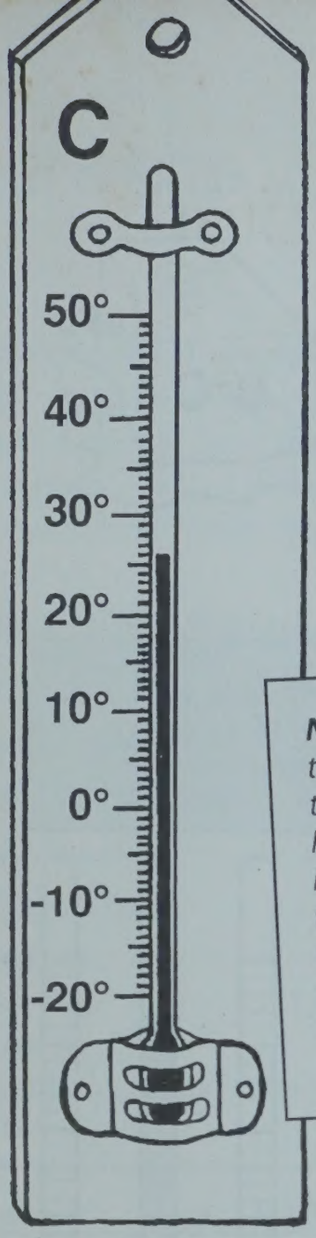
Mercury is a very poisonous metal. It is a liquid at room temperature. **You should never touch mercury.** Even the invisible, odourless fumes that mercury gives off are dangerous to breathe. In case you break a mercury thermometer, you should let an adult carefully scoop up the mercury onto a piece of paper without touching it and bury it somewhere safe.

Try to get thermometers that are filled with coloured alcohol instead of mercury, since they are safer. The alcohol is usually coloured red.

The Temperature of Air

Just as we can measure our body's temperature, we can also measure the temperature of air. But for this a different kind of thermometer is used, and its scale is usually in Celsius units (as shown on the right).

Bring a Celsius thermometer to the classroom. Note what temperature the thermometer shows. This is the present temperature of air in your classroom.



The Meteorological Department

This is a department of the government that has its offices in many different parts of the country. Each office records the daily temperatures. All the countries of the world have such weather bureaus recording the temperatures of various places. Thus, we can get information about the temperatures of numerous places all over the world, for every day, every month and every year.

Official temperatures are measured at a distance of 1.6 metres above the ground under a structure that provides shade from the sun and exposure to air, and is away from any walls that might radiate heat.

Note: *Always measure the air temperature in the shade, not in the sun. Keeping a thermometer in the sun may cause it to rise to a temperature that is much higher than the air temperature – the thermometer might even break!*

To get an idea of other temperatures, measure and note the temperature of the following things. Before you start measuring, guess the temperature of each one.

Thing	Temperature	
	Guess	Measurement
A bucket of water		
Water in a mutka		
Ice		
A glass of cold water		
Warm bath water		

It is safer and advisable to use thernometers that have a scale of -10°C to 110°C. Using such a thermometer, also measure and note the temperature of boiling water and hot tea.

For the next week, measure the air temperature each day at the same time and place. (Remember to choose a place that is in the shade.) Each day before you measure, write down your guess. Keep your record in a separate notebook.

Place _____

Time _____

Month _____

Date	Air Temperature	
	Guess	Measurement

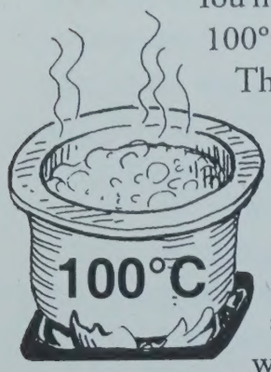
If you measure the temperature for a week in different months throughout the year, you will be able to see the temperature differences that occur between the summer, winter, monsoon, and other seasons.

Record the temperature every day for one week for a few different months.

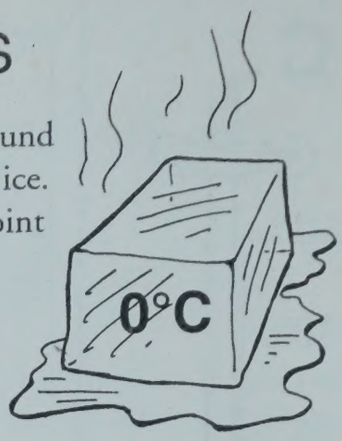
Calculate the average temperature for each week that you make measurements.

Discuss the variations between different weeks.

High and Low Temperatures



You must already know that when water reaches a temperature around 100°C it starts boiling, and at about zero (0°C) it freezes into ice. That's why these temperatures are known as the boiling point and the freezing point.



There is no place on the earth where the air temperature gets 'boiling hot'. It never reaches 100°C. But there are many places where the air temperature has reached 0°C and even lower. Do you know how temperatures are written when they are lower than 0°C? They are written by writing a negative sign (-) in front of the temperature. Let's say that the temperature of a certain place is 5°C below 0. Then we'll say it's minus five degrees Celsius (-5°C).

-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8

Fill in the blank under each of the following thermometers to tell what temperature it shows.

Which temperature is greater: 5°C or -5°C?

At which of these two temperatures will we feel colder?

How many degrees difference is there between -5° and 5°?

Write in short form each of the following temperatures:

88 degrees below zero, Celsius

38 degrees above freezing, Celsius

32 degrees below freezing, Celsius

Did you note the temperature in your classroom today? 88 degrees below zero Celsius is how many degrees lower than the temperature you measured?

The temperature of a normal human body is 37°C. Therefore 50°C is how much hotter than normal body temperature?

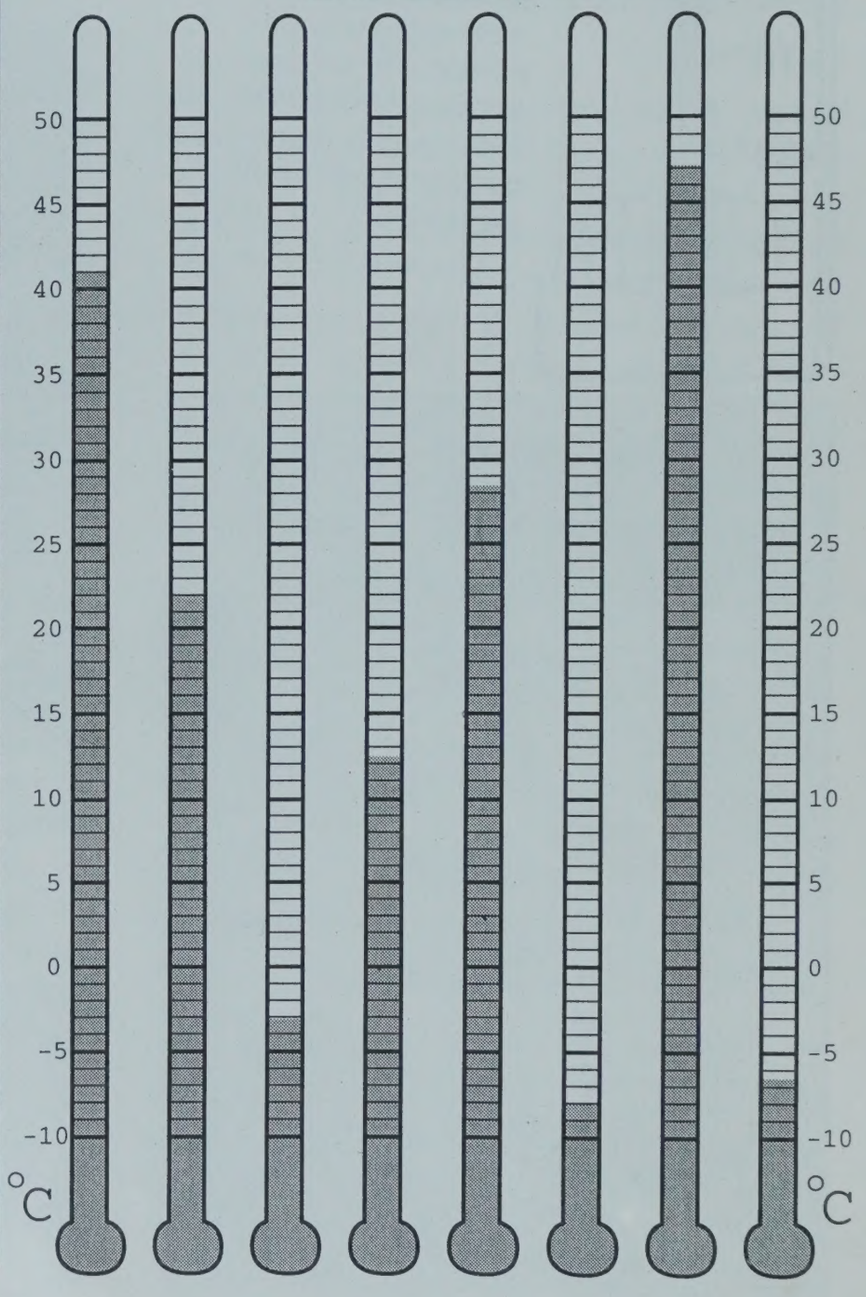
How much colder than the normal body temperature is -5°C?

Arrange the following temperatures in order from the highest to the lowest:

12°C, -16°C, 29°C, 0°C, -4°C

At which of the above temperatures will we feel hottest?

At which of the above temperature will we feel coldest?



Extreme Temperatures

Sometimes it gets extremely hot or extremely cold. Table 1 shows some of the lowest (minimum) air temperatures that have ever been recorded in various places. Table 2 shows some of the highest (maximum) air temperatures.

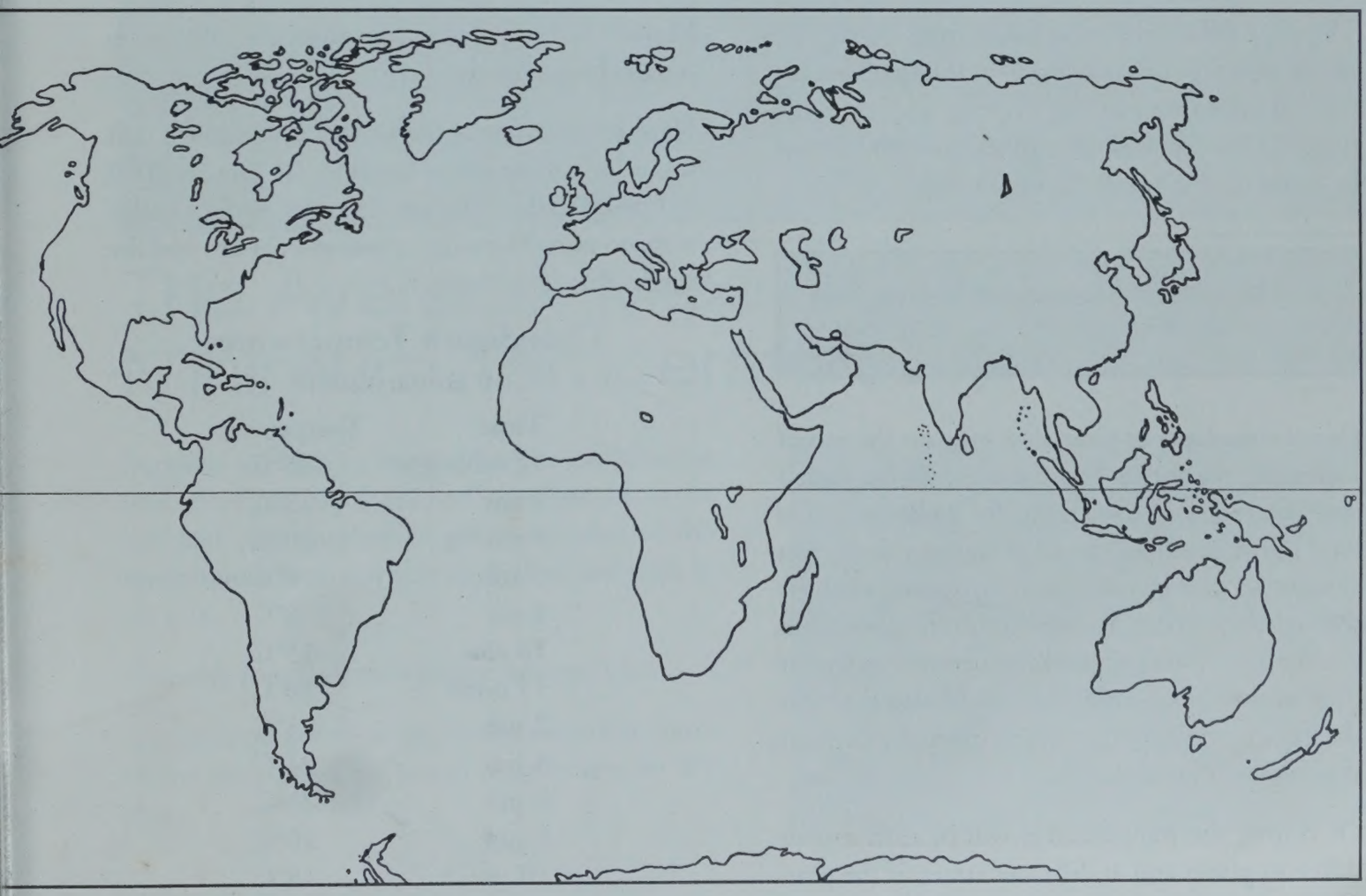
Table 1: Cold Extremes

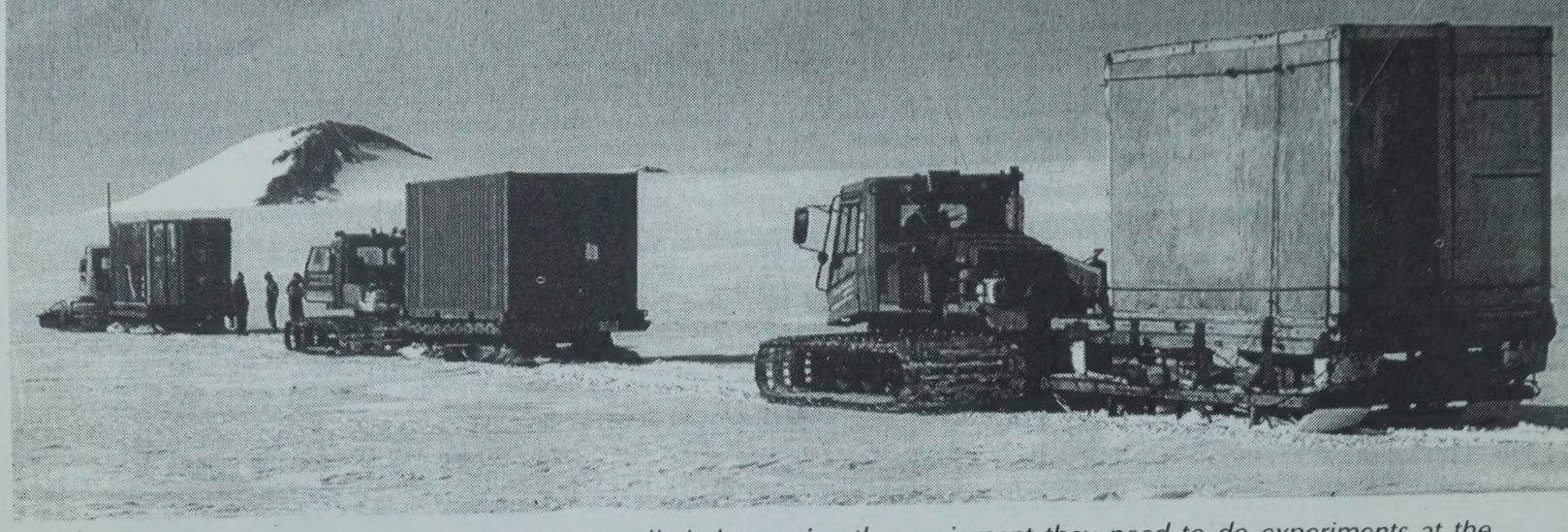
Place	Date	Temperature
Vostok Station, Antarctica	21 July 1983	-89.2°C
Oimyakon, Siberia, Russia	6 Feb 1933	-68°C
Northice, Greenland	9 Jan 1954	-66°C
Snag, Yukon, Canada	3 Feb 1947	-63°C
Prospect Creek, Alaska, USA	23 Jan 1971	-62°C
Charlotte Pass, New S.Wales, Australia	29 June 1994	-22°C

Table 2: Hot Extremes

Place	Date	Temperature
Azizia (Al Aziziyah), Libya	13 Sept 1922	57.8°C
Death Valley, California, USA	10 July 1913	56.7°C
Tirat Tsvi, Israel	21 June 1942	54°C
Pad Idan, Pakistan	23 May 2002	50.6°C
Cloncurry, Queensland, Australia	16 Jan 1889	53°C
Seville, Spain	4 Aug 1881	50°C

Use your Atlas to find the locations of the places in Tables 1 and 2. Mark their (approximate) positions on the following map. Mark the coldest places in blue and the hottest places in red.





Scientists use special snow tractors to pull sleds carrying the equipment they need to do experiments at the Indian research station in Antarctica.

In which parts of the earth are these very hot and very cold places in Tables 1 and 2 located? Use your Atlas to tell whether any of them are in each of the following parts of the earth (the first one is done for you):

Parts of the earth	Cold extremes	Hot extremes
a) Areas near the South Pole	yes	no
b) Areas near the Equator		
c) Areas near the North Pole		
d) Hot deserts		
f) Tropical rain forests		

The Temperature Keeps Changing Throughout the Day

The temperature rises and falls during the day. So much variation can take place in the temperature from the morning to the evening and then the night! In some places the temperature can change by more than 20 or 30°C in one day!

Based on your past experience, when do you think are the hottest and coldest times of day or night?

Can the students in your class take on the job of measuring the outdoor temperature (in the shade) every hour or every two hours for 24 hours in one day? How could you do it? If you can do it, you can get an idea of how the temperature changes throughout one day. You could then find out what was the maximum (highest) temperature and what time of day it occurred. You could also find out the minimum (lowest) temperature and when was the coldest time of the day.

Of course, the temperatures will be different in different places and at different times of the year. Maybe the time of the maximum and minimum temperature will also vary.

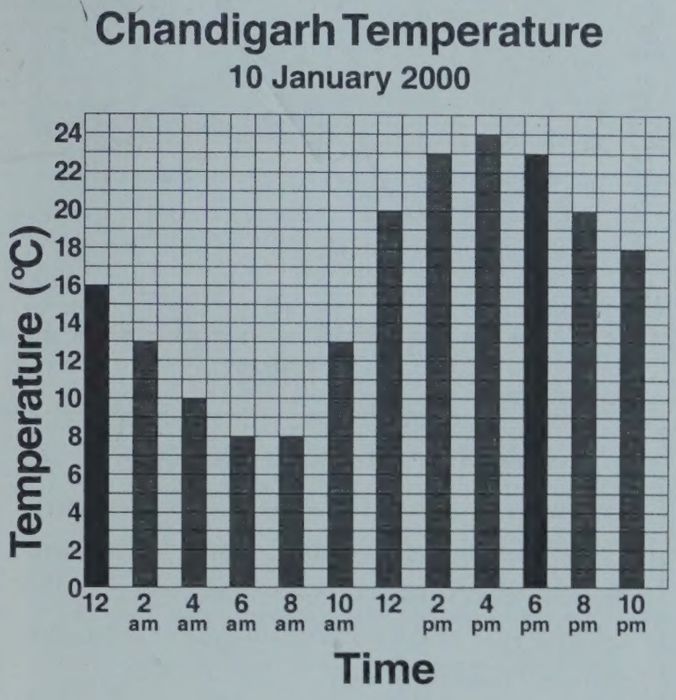
Here is a chart that shows the temperature that was measured every two hours on 10, January 2000 in Chandigarh. (The weather was partly cloudy, with no rain. The sunrise was at 7:21 am and the sunset was at 5:39 pm.)

Chandigarh Temperatures
10 January 2000

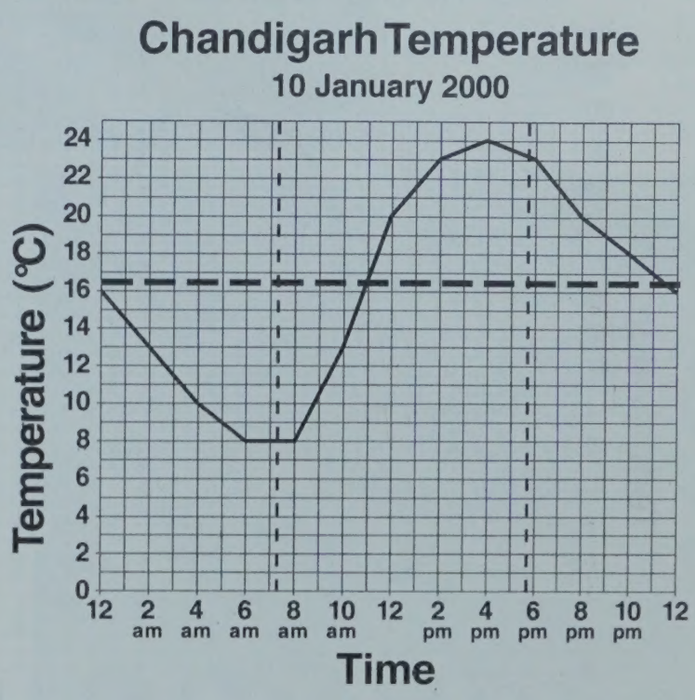
Time	Temperature
12 midnight	16°C
2 am	13°C
4 am	10°C
6 am	8°C
8 am	8°C
10 am	13°C
12 noon	20°C
2 pm	23°C
4 pm	24°C
6 pm	23°C
8 pm	20°C
10 pm	18°C

We can make graphs to show how the temperatures rose and fell that day in Chandigarh. Here are two graphs of the same data.

This bar graph is just like a row of thermometers.



To make this line graph, we just drew one point at the top of each bar and then connected the points. The thin vertical dashed lines show the times of sunrise and sunset.



Answer the following questions about the above temperatures for 10 January in Chandigarh:

What was the maximum (highest) temperature?

What was the minimum (lowest) temperature?

When did the temperature start increasing?

When did the temperature start decreasing?

When was the warmest part of the day?

When was the coolest part of the day?

Why were those times the warmest and coolest? Discuss what factors may determine when the warmest and coolest times will be.

Do you think the warmest and coolest times will be the same in your area?

The Average, Maximum, and Minimum Temperatures

Suppose we want to know what the temperature was on 10 January 2000 in Chandigarh. Can we use just one number to get some idea of the temperature for the whole day? There are ways to do this.

One way is to find the **average temperature**.

The horizontal dashed line in the above line graph shows the average (or mean) temperature for the day.

Use the 12 measurements of temperature in Chandigarh to calculate the average (mean) temperature for 10 January, as follows:

First add up all the temperatures.

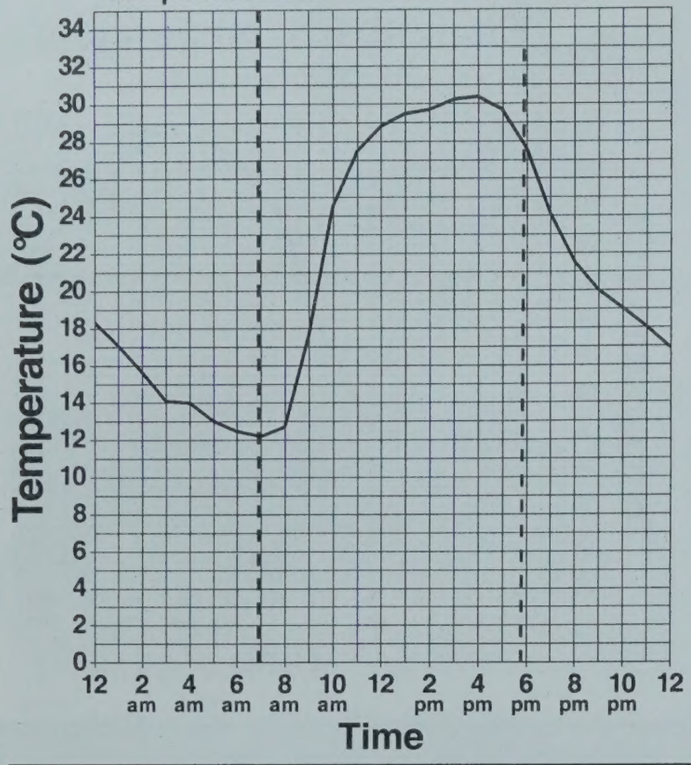
Then divide this sum by the total number of temperatures (12 in this case).

Do you get the same number that is shown by the horizontal line in the graph?

Draw a line on the following graphs to show what you guess the average temperature was. Also, tell what the maximum and minimum temperatures were and when they occurred.

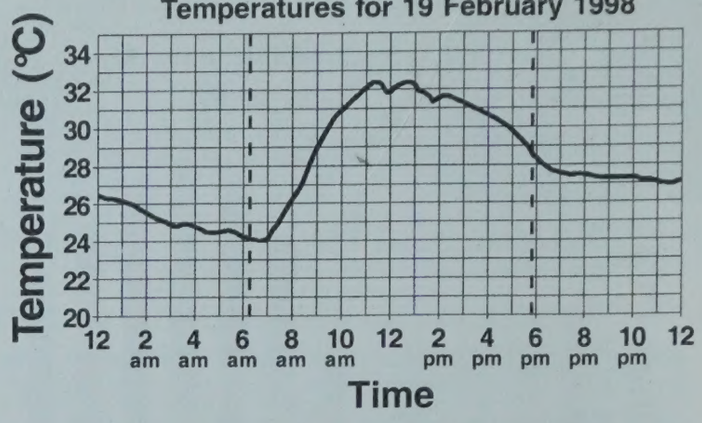
Indore, M.P.

Temperatures for 10 December 2002



Kalpakkam, T.N. (near Chennai)

Temperatures for 19 February 1998



Weather Bureau Reports

In many Weather Bureaus the temperature is not recorded every hour. Instead, there are special thermometers that automatically record just the maximum and minimum temperature each day.

Average Temperatures for each Month

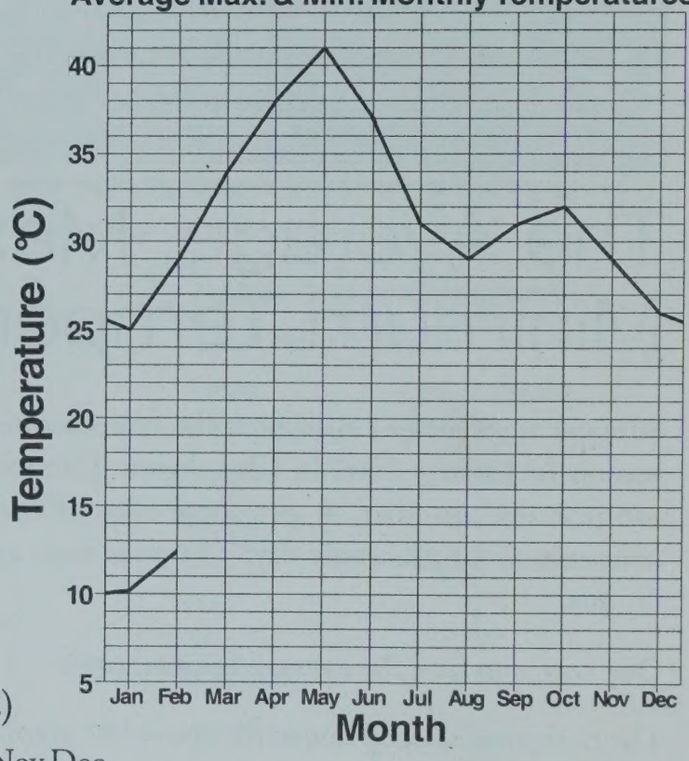
If you know the maximum temperature for each day of a month, you can calculate the **average (mean) maximum temperature** for the month. You simply add up the maximum temperature of every day of the month, and then divide by the total number of days in the month. For example, you will add 31 maximum temperatures for January and then divide by 31.

Similarly, the **average minimum temperature** can be calculated by adding up all the minimum temperatures and dividing by the total number of days.

The same kind of calculation has been done for each month in Bhopal. The following Table gives the average maximum and minimum temperatures that were found. The average maximum monthly temperatures for the entire year were then plotted, as shown on the right.

Bhopal

Average Max. & Min. Monthly Temperatures



Average Monthly Temperatures in Bhopal (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MAX:	25	29	34	38	41	37	31	29	31	32	29	26
MIN:	10	12	17	22	26	25	23	22	21	18	14	11

Tajul Masajid and Motia Talaab, Bhopal

Use the data in the Table to plot the average minimum monthly temperatures for Bhopal on the same graph. The first two months have already been done for you.

Look at the data and the graphs to answer the following questions about Bhopal:

How cold does it usually get in November in Bhopal?

Which month has the highest maximum temperature in Bhopal? What is the average maximum temperature for that month?

What is the difference between the highest maximum temperature and the lowest maximum temperature in the year?

Which three months get the hottest in Bhopal?

Which three months get the coldest?

What is the average maximum temperature in January in Bhopal?

From June through December, the average minimum monthly temperature keeps falling in Bhopal. Does the average maximum monthly temperature also keep falling?

What is the difference between the maximum and minimum temperature in May?

What is the difference between the maximum and minimum temperature in August?

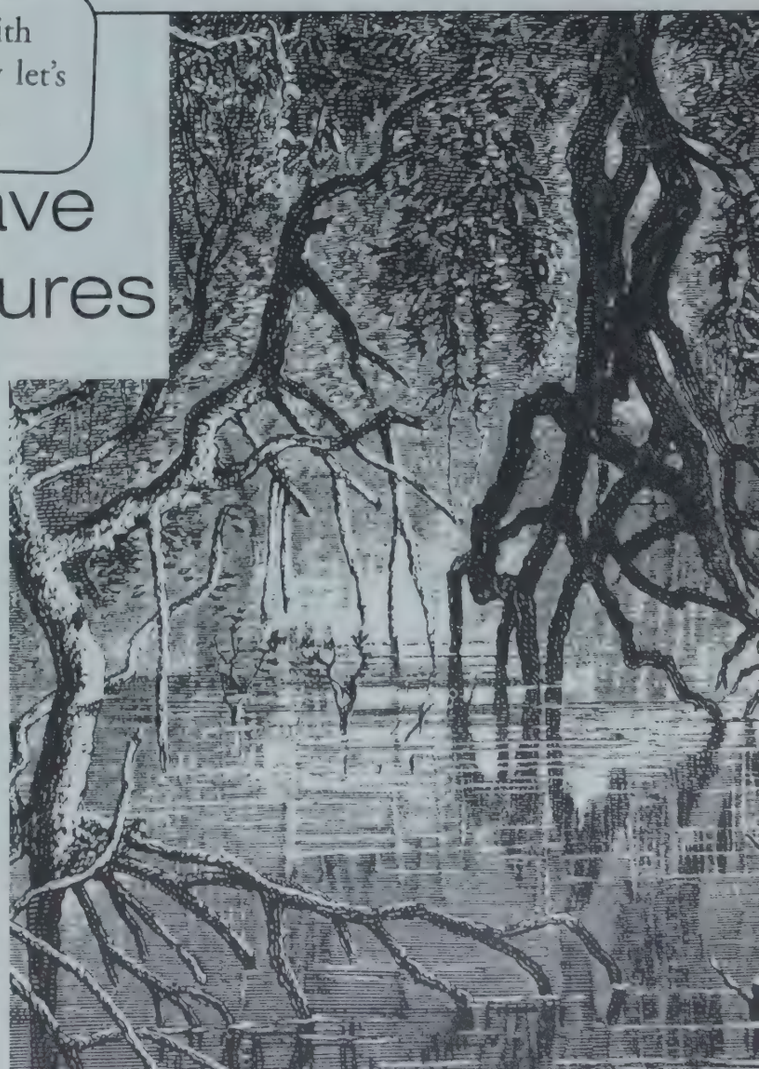
Based on your answers to the above two questions, is there a larger difference between the maximum and minimum temperatures in the summer or in the rainy season in Bhopal?

We have seen that temperature varies with the time, the day, and the month. Now let's find out how it varies in different places.

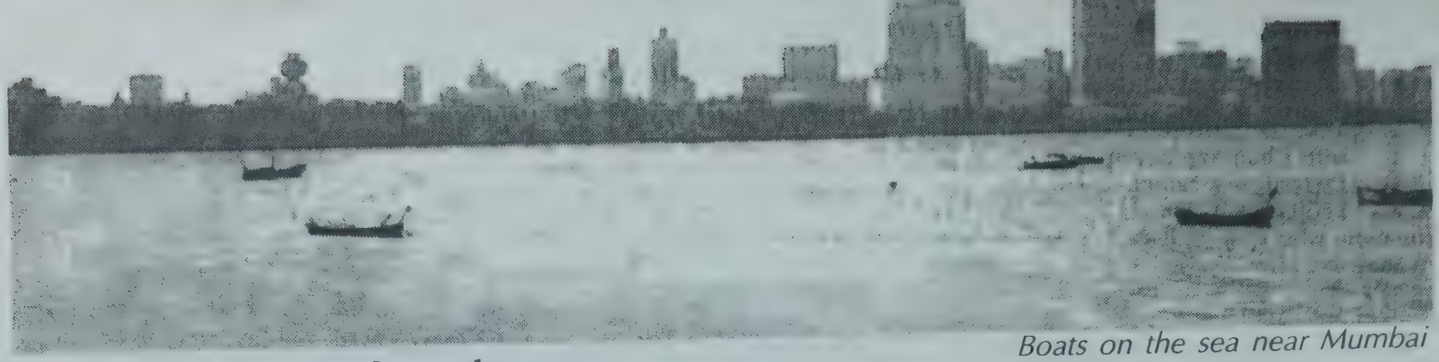
Different Places Have Different Temperatures

You know that different places have different temperatures. Do you know **why** they have different temperatures? There are many reasons. Now we'll take a look at some of the possible reasons.

You already know that temperature changes as we go north or south from the Equator. Places that are near the sea usually have different temperature patterns than places far away from the sea. Temperatures differ on the top of a mountain and at its foot.



Do you think it gets extremely hot in this mangrove swamp near the coast?



Boats on the sea near Mumbai

Places Near and Far from the Sea have Different Temperatures

We have already seen the average temperatures of Bhopal. Bhopal is far away from the sea. Now let's look at the temperatures of a city that lies next to the sea: Mumbai.

Average Monthly Temperatures in Mumbai (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MAX:	30	30	31	32	33	32	30	30	30	32	33	31
MIN:	19	20	23	25	27	26	25	25	25	25	23	21

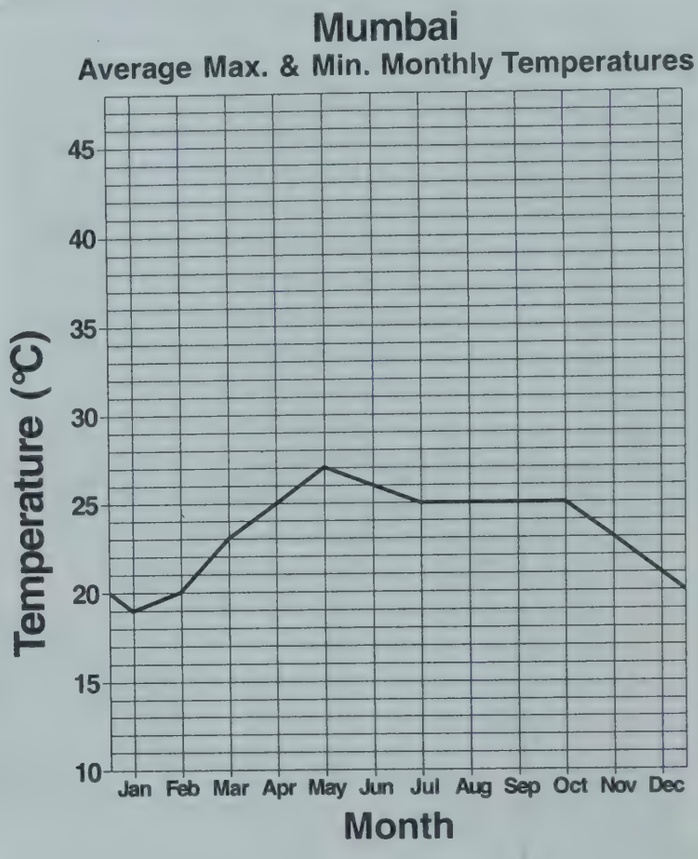
Plot the average maximum monthly temperatures in Mumbai on the following graph that already shows the average minimum temperatures in Mumbai.

Which month has the lowest minimum temperature in Mumbai? How much is it?

Which is the hottest month in Mumbai? How much was the average maximum temperature for that month?

Compare the temperatures of Bhopal and Mumbai to answer the following

- *In January, which place is colder?*
- *In June, which place is hotter?*
- *In which place, Bhopal or Mumbai, does the temperature remain more or less the same throughout the year?*



Moderate and Extreme Climates

Why does the temperature in Mumbai not change much throughout the year? Because it is on the seashore! The sea heats up slowly and cools down slowly. Since the sea doesn't get too hot or cold, the air above the sea also doesn't get too hot or cold. Therefore places near the sea usually have temperatures that remain fairly constant throughout the year. They have what is known as a **moderate** (insular) climate.

In contrast to this, Bhopal is far away from the sea. There is no moderating influence of the sea in Bhopal. In the summers the ground temperature rises very high and this heats up the air. In winters the ground temperature falls and the air is also cold. This is called an extreme or continental climate (that is, one with great differences between maximum and minimum temperatures daily and also over the year).

An Experiment

Does the sun heat up water just as quickly as it heats up soil? Can you design an experiment that tells you the answer to this question? Discuss your design for an experiment and what results you expect. Then try out the experiment and see what happens.

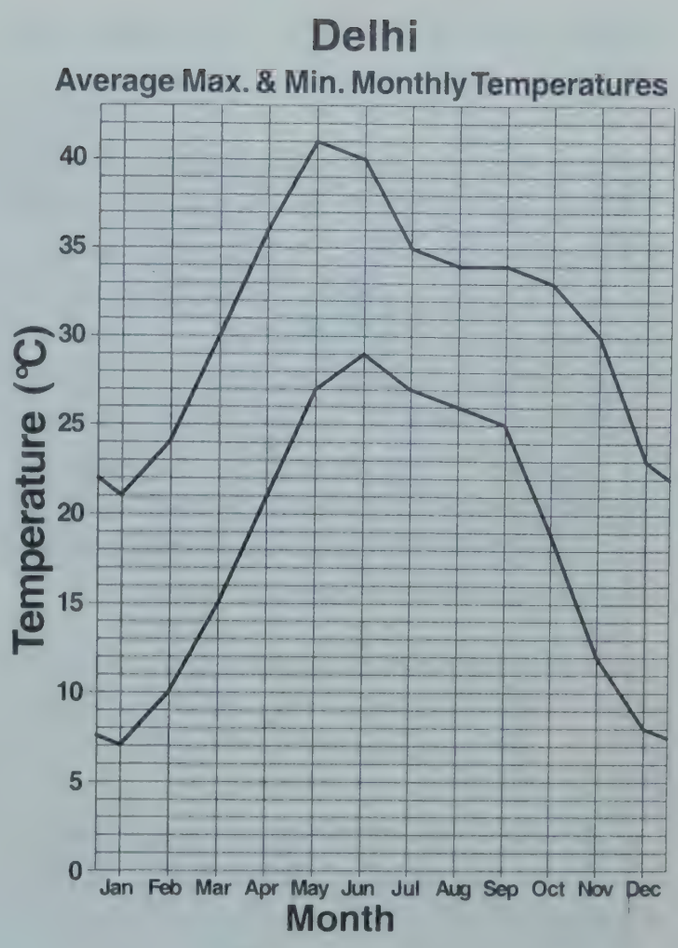
Height and Temperature

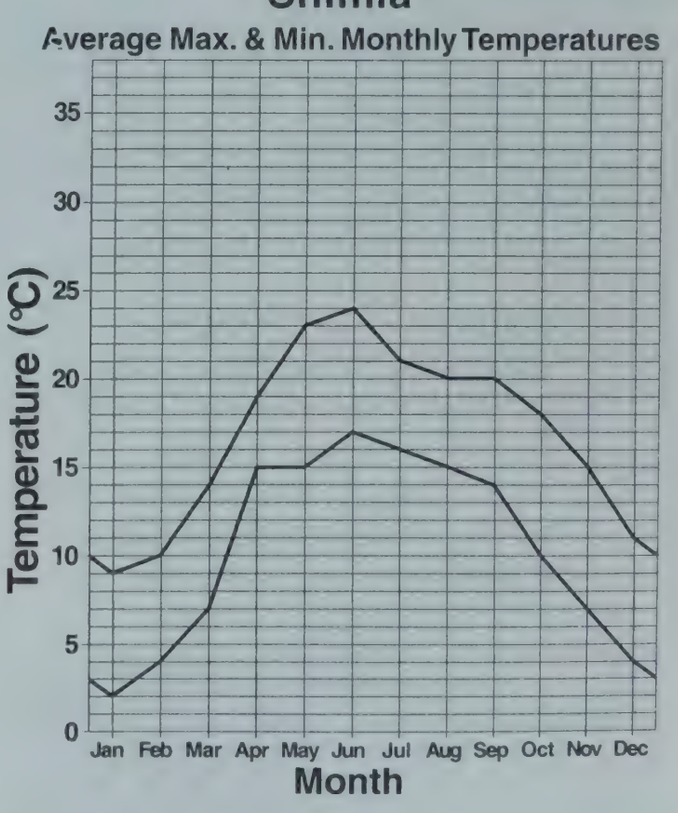
At the peak of summer some people go from the plains to hilly places such as Pachmarhi or Shimla to avoid the heat. Even in the summer months the temperatures on high hills are low. The highest parts of a mountain generally have the lowest temperatures. Temperature decreases with elevation (height).

Look at the Graphs showing the average monthly temperatures of Delhi and Shimla. You can see quite clearly that in each month of the year the temperature of Shimla is far lower than that of Delhi.

Delhi is at an elevation (height) of about 200 metres above sea level, while Shimla is at an elevation of about 2200 metres above sea level.

Usually, for every 1000 meters increase in elevation, the temperature falls by about 6°C.





How many meters higher than Delhi is Shimla?

Based on the difference in elevation, calculate about how much difference in temperature there should be between the two places.

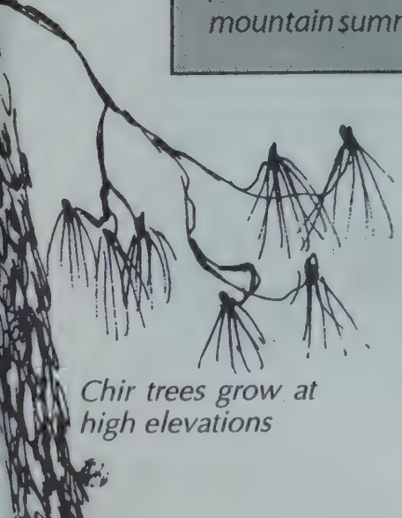
Which month has the highest maximum temperature in Shimla? How much is it?

Which month has the highest maximum temperature in Delhi? How much is it?

In September the average maximum temperature in Shimla is _____ °C while in Delhi it is _____ °C.

Compare and contrast the temperature for the month of January for Delhi and Shimla.

Take another look at the Extreme Temperatures in Table 1 at the beginning of the Chapter. Which places in this Table are on mountain passes or mountain summits?



Chir trees grow at high elevations

Since the temperature does not get so high at higher elevations, there is also a difference in the kinds of plants that grow high on hills and mountains. You can read about this in the chapter on mountains.

Temperatures in Places Near and Far from the Equator

In Class 6 we read about Indonesia, which is situated on the Equator. We also read about Iran and Japan, which are more to the north, and about the arctic tundra, which is even further north. We came to know that equatorial regions like Indonesia are quite hot throughout the year and they have no winter. As we go north or south from the equator it becomes colder, and there are separate summer and winter seasons. A look at the temperatures of places near and far from the equator will illustrate this quite clearly.

Given in the table are the average temperatures of three places: Singpore, Tokyo, and Vladivostok. The average temperature for the whole year is shown. This is calculated by adding up all the maximum and minimum temperature readings for every month and then dividing by the total number of readings. Thus, we get to know the average temperature on an average day in the year. We might use this number to answer a question like, "Is Singapore, on average, warmer than Shanghai?"

City	Average Temp. for the year
Singapore	27.8°C
Shanghai	15.3°C
Vladivostok	3.9°C

Places near the Equator usually get more heat. Places further away from the Equator often have lower average temperatures for the year.

Which of the three places is located near the Equator?

What is the average yearly temperature in that place?

Which of the three places on the Graph is farthest from the Equator?

What is the average yearly temperature there?

Find out the locations of Singapore, Shanghai, and Vladivostok, and mark them on this picture of the Earth.

The yearly average temperatures of some cities are as follows:

City	Average Temp. for the year
Tokyo	*16°C*
Helsinki	*4°C*
Mumbai	*---°C*

Find out the locations of the above cities and plot them on the above picture of the Earth.

From the information on Page 8 and 10, Calculate the yearly average temperature for Bhopal and Mumbai.

Do these figures indicate that as we go further from the Equator, it becomes colder?

Temperature Maps

India is a vast, sprawling country and the temperature varies in its different regions. If we want to find out which places are hotter and which are colder, we can use a temperature map.

Look in your Atlas to find the map of India that shows the average (mean) temperatures in January. This average temperature is the average of the maximum and minimum temperatures for the month of January.

In this map India has been divided into different sections, each marked with a different colour. By referring to the key you can find out the average temperature in January in each of these sections.

Use the maps in your Atlas to find out the latitude and the average temperature in January of each of the following places. The first one has already been done for you.

Place	Lat.	Temperature in January
Madurai, T.N.	*10 °N*	*between 25 and 30°C*
Hyderabad, A.P		
Bhopal		
Delhi		

According to this map, there is no place in India that has an average January temperature higher than 30°C. (Remember, this is the average. There may be some January days in some places that do get hotter than 30°C.)

Look at the map given on page 16 and find out which parts of India usually have the highest average temperature (in January).

If you look north from this place on the map, is the average January temperature higher or lower?

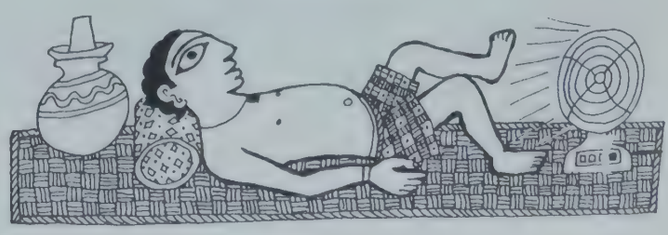
India Heats Up

Look at the map of India in your Atlas that shows the average temperatures in April.

What is the average temperature in April at the following places:

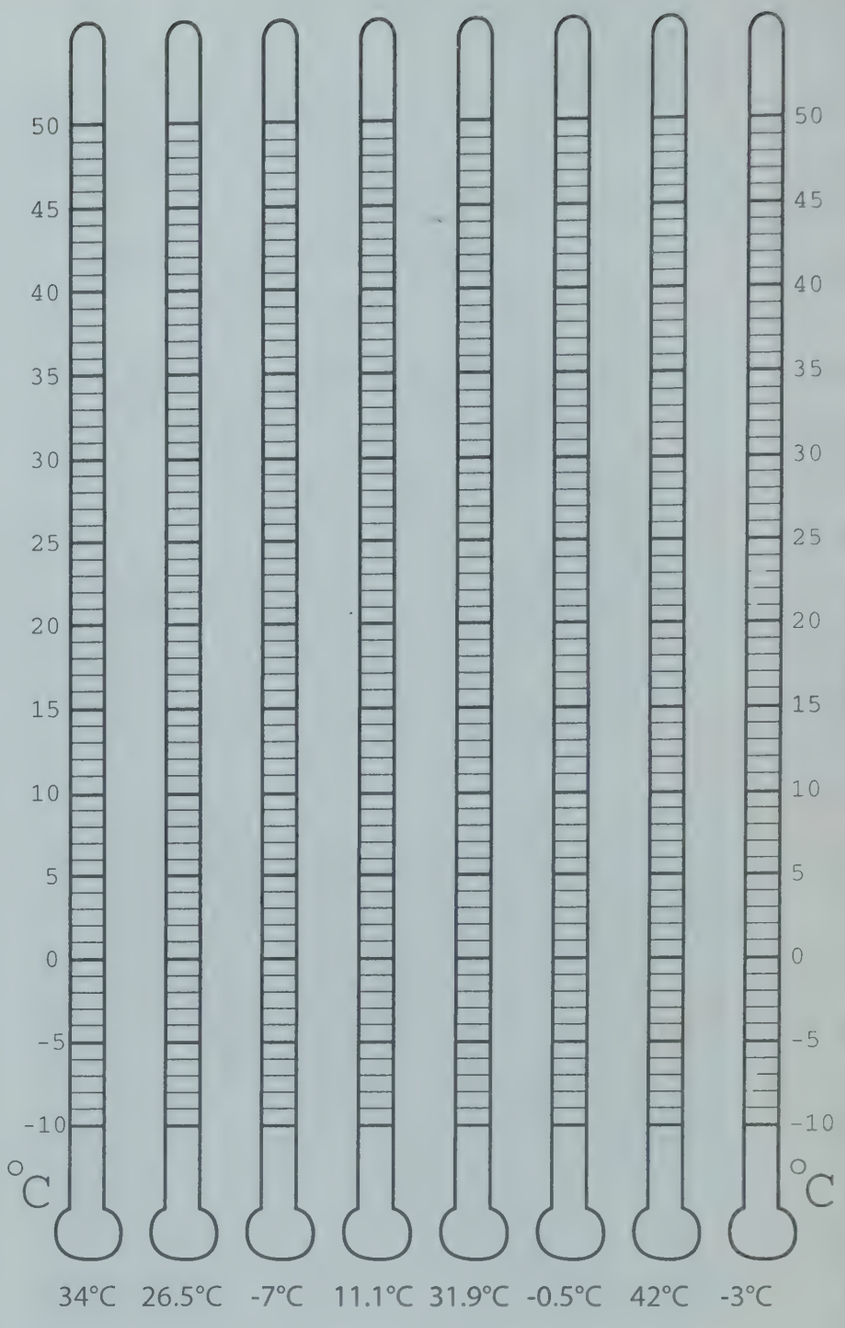
Place	Temperature in April
Madurai	*between 27.5°C and 30°C*
Hyderabad	
Bhopal	
Delhi	

If you look carefully at this map in your Atlas you will find the average (mean) temperature of almost all of India has gone up over 25°C. What a change from the situation in January! Only in the higher parts of the Himalayas and in the Northeastern hills does the average temperature still remain below 25°C. That is to say, in just three months almost the entire landmass of India has become quite hot.



Exercises

1. Colour each of the thermometers on the right to show the temperature written underneath.



2. What's the difference between the highest temperature in Table 2 and the lowest temperature in Table 1on page 5 ?

3. Water freezes at 0°C (32°F) and boils at 100°C (212°F). The normal human body temperature is 37°C (98.6°F). Rohini's body temperature rose from 37°C to 38°C. Harish's body temperature rose from 98.6°F to 99.6°F. Who had the higher fever, Rohini or Harish?

4. A girl in Srinagar noticed one morning that the puddles of water that were outside her house had frozen into ice. What might the air temperature have been that morning? Tick the correct answer and give reasons why it is correct and why each of the others are incorrect.
   a) 4°C
   b) 10°C
   c) -3°C
   d) -88°C

5. Suppose the temperature in Moscow was –4 °C at 10 am on 6 December. Twenty-four hours later it was 6 °C higher. What was the temperature at 10 am on 7 December?

6. In Bhopal, the average maximum temperature for January is 25°C. Therefore: (tick one)
   a) The maximum temperature on 8 January is 25°C.
   b) The temperature never goes higher than 25°C throughout January.
   c) The temperature at 12 noon on 12 January is 25°C.
   d) The maximum temperature on 28 January, 2003 could have been 27°C.

7. Delhi and Mumbai are both situated on plains and their height above sea level is less than 300 meters. Why is there so much difference in their monthly average temperatures? In which months are the average temperatures in these two cities most similar? Can you explain why?

8. Given below are the average monthly minimum and maximum temperatures of Jodhpur. Make a line graph of them. Which are the hottest and coldest months of the year?

Average Monthly Maximum Temperatures in Jodhpur, Rajasthan (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	9	12	17	22	27	29	27	25	24	20	14	11
Maximum	25	28	33	38	42	40	36	33	35	36	31	27

9. Given here are the average maximum temperatures of three places: A, B, and C. Plot them on a graph. What can you guess about each place by looking at the Table and Graphs?

Place	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A	23	26	33	38	41	39	34	33	33	33	29	25
B	-3	1	6	12	17	21	25	24	21	14	8	2
C	31	32	33	32	32	29	29	29	30	30	30	31

10. Give three possible explanations for the differences between the average temperatures in Thiruvananthapuram and Shimla in January (refer to your Atlas).

11. Between Bhopal, Delhi, Mumbai and Shimla, which two places show a similar temperature pattern? How can you explain the similarity between these two places?

12. Look at the graph on the right and answer the questions below.

    a) Does this look like the temperature graph of a place by the sea? Explain.

    b) What is the average highest temperature in July in Bangalore?

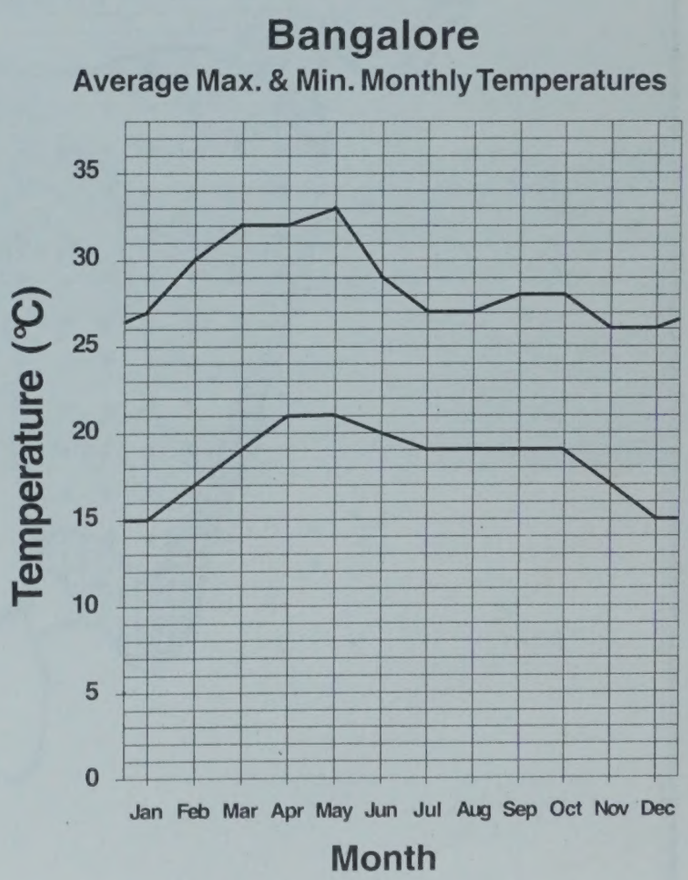
    c) How warm does it usually get in December in Bangalore?

    d) Compare the December temperatures of Bangalore and the place where you live in.

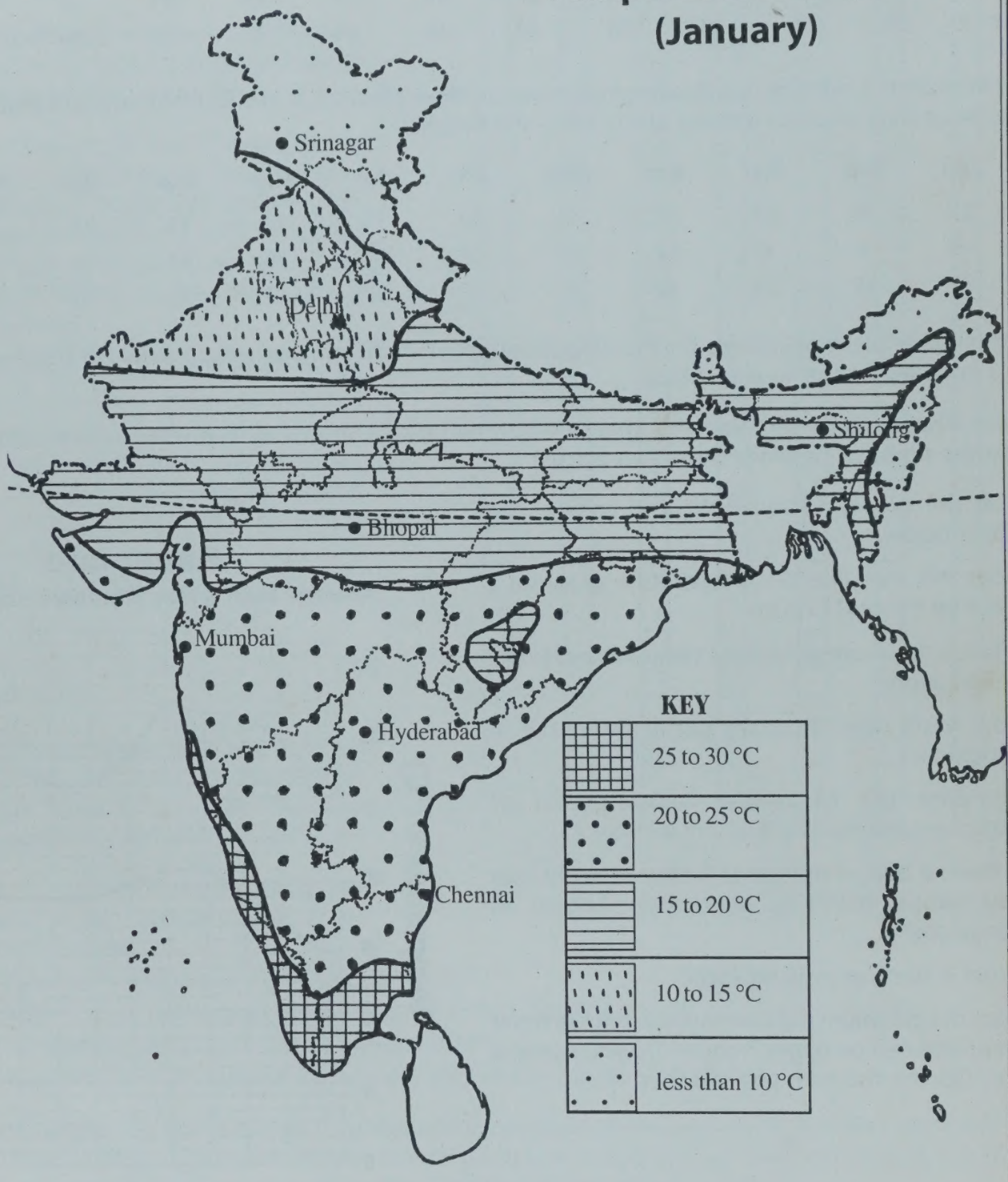
    e) Is there a bigger difference between night and day temperatures in May or in August in Bangalore?

    f) When is summer in Bangalore?

13. Compare the minimum daily temperature of the three p laces mentioned on pages 7 and 8? Do you notice a pattern? Discuss this with your teacher.



Average Winter Temperatures in India (January)



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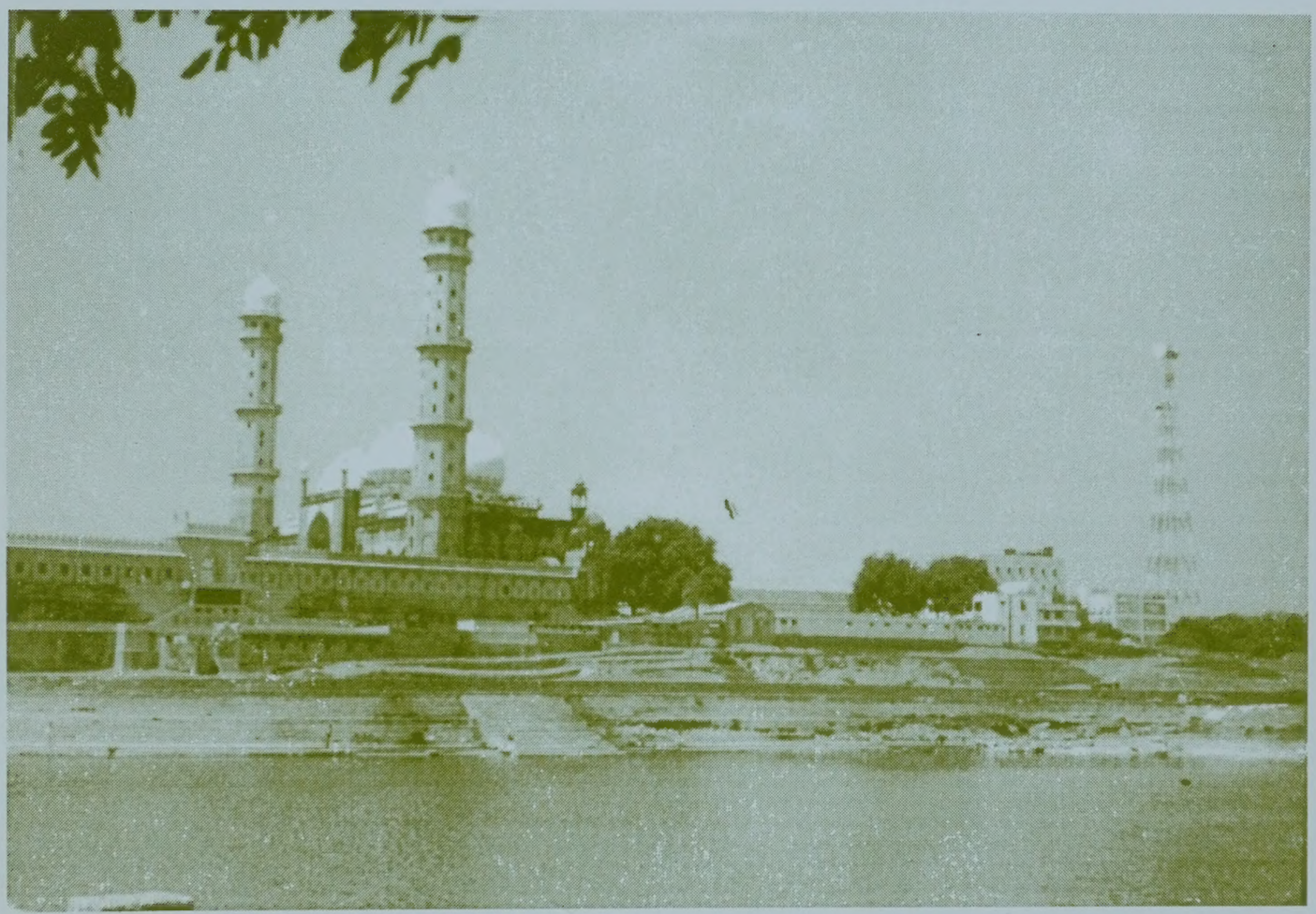

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